Heat from the earth

Heat is a form of energy and geothermal energy is literally the heat contained within the Earth that generates geological phenomena on a planetary scale. Geothermal energy in modern technologies is derived from natural heat. In effect, the earth serves as a boiler in which geothermal fluids can achieve the high temperatures and pressures necessary for commercial development. Typically, these fluids occur in reservoirs at depths of up to 3000 meters and can be recovered by drilling wells. Surface facilities convert geothermal heat into useful forms of energy like electricity or heat for other purposes e.g. heating houses.

The Earth's thermal engine

The heat inside the Earth core is continually generated by the decay of the long-lived radioactive isotopes of uranium, thorium and potassium, which are present in the Earth. Added to this heat, there are other potential sources of heat such as the primordial energy of planetary accretion.

Some interesting facts:

- The heat generated in the Earth's interior and the heat dissipated into space from the Earth seems to be not in equilibrium. According to the theory our planet is cooling down. The cooling process is, however, very slow.
- The temperature of the mantle has decreased no more than 300-350°C in three billion years, remaining at about 4000°C at its base.
- Estimates from more than twenty years ago gave the total heat content of the Earth, reckoned above an assumed average surface temperature of 15 °C, in the order of 12.6 x10E24 MJ, and that of the crust in the order of 5.4 x 10E21 MJ.
- The geothermal gradient expresses the increase in temperature with depth in the Earth's crust. Down to the depths accessible by drilling with modern technology, the average geothermal gradient is about 2.5-3 °C/100 m.
- For example, if the temperature within the first few metres below ground-level, which on average corresponds to the mean annual temperature of the external air, is 15 °C, then we can reasonably assume that the temperature will be about 65°-75 °C at 2000 m depth, 90°-105 °C at 3000 m and so on for a further few thousand metres.
- There are, however, vast areas in which the geothermal gradient is far from the average

value. In areas in which the deep rock basement has undergone rapid sinking, and the basin is filled with geologically "very young" sediments, the geothermal gradient may be lower than 1 °C/100 m.

- On the other hand, in some "geothermal areas" the gradient is even higher than ten times the average value.
- Our planet consists of a crust, which reaches a thickness of about 20-65 km in continental areas and about 5-6 km in oceanic areas, a mantle, which is roughly 2900 km thick, and a core, about 3470 km in radius. The Earth's crust, mantle, and core.

Making use of this energy

The thermal energy of the Earth is therefore immense, but only a fraction can be utilized by man. So far our utilization of this energy has been limited to areas in which geological conditions permit a carrier (water in the liquid phase or steam) to "transfer" the heat from deep hot zones to or near the surface, thus giving rise to geothermal resources, but innovative techniques in the near future may offer new perspectives in this sector.

The extremely slow movement (a few centimetres per year) of the earth's plates is maintained by the heat produced continually by the decay of the radioactive elements and the heat coming from the deepest parts of the Earth. Immense volumes of deep, hotter rocks, less dense and lighter than the surrounding material, rise with these movements towards the surface, while the colder, denser and heavier rocks near the surface tend to sink, re-heat and rise to the surface once again; very similar to what happens to water boiling in a pot or kettle. In zones where the lithosphere is thinner, and especially in oceanic areas, the lithosphere is pushed upwards and broken by the very hot, partly molten material ascending from the asthenosphere, in correspondence to the ascending branch of convective cells.

It is this mechanism that created and still creates the spreading ridges that extend for more than 60,000 km beneath the oceans, emerging in some places (Azores, Iceland) and even creeping between continents, as in the Red Sea. A relatively tiny fraction of the molten rocks upwelling from the asthenosphere emerges from the crests of these ridges and, in contact with the seawater, solidifies to form a new oceanic crust.